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Theater Deployable Communications

Baseline Requirements Document

Large Voice Module
LVM (v3)
Nov 2003

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Approved for public release; distribution is unlimited.

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1.0   SCOPE

This requirements document establishes the performance, manufacture and test requirements for the TDC ICAP Large Voice Module (LVM) v3.

2.0 APPLICABLE DOCUMENTS

To the extent specified herein, the following documents of latest current issue on the date of this Baseline Requirements Document form part of this BRD.

Table 1 - Standards and Applicable Documents

Document Number	Title
	Theater Deployable Communications Standards Document
ANSI Std. T1.102	American National Standard for Telecommunications - Digital Hierarchy - Electrical Interfaces
ANSI Std. T1.107	American National Standard for Telecommunications - Digital Hierarchy-Formats Specifications
ANSI T1.601-1992	American National Standard for Telecommunications - Minimal Set of Bearer Services for the ISDN S Interface
ANSI T1.603-1990	American National Standard for Telecommunications - Minimal Set of Bearer Services for the ISDN Primary Rate Interface
ANSI TIA/EIA-470-B 1997	Telephone Instruments with Loop Signaling for Voice Applications
ATT Pub. 43801	Digital Channel Bank Requirements and Objectives
EIA-232	Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange (Rates to 20 kbps)
ISO/IEC 8802-3 1996 ANSI/IEEE Std. 802.3	Information Technology- Local Metropolitan Area Networks-- Part3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specification. (Documents are one in the same; from IEEE, ANSI, ISO and IEC)
ITU Q.310 -- Q.326	[Signaling System R1, Various Recommendations]
ITU Q.920	ISDN User-Network Interface - Data Link Layer, General Aspect - Digital Subscriber Signaling System No.1
ITU Q.921	ISDN User-Network Interface - Data Link Layer Specification - Digital Subscriber Signaling System No.1
ITU Q.930	ISDN User-Network Interface - Layer 3, General Aspects - Digital Subscriber Signaling System No.1
ITU Q.931	ISDN User-Network Interface -Layer 3 Specification - Digital Subscriber Signaling System No.1
ITU X.25	Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Terminals Operating in the Packet Mode and Connected to Public Data Networks by Dedicated Circuit
MIL-STD-810F	Environmental Test Methods
*REDCOM Laboratories, Inc. 008421-V60, -EV60	IGX•C ISDN Gateway Exchange User's Manual V6.X
REDCOM Laboratories, Inc. 008836-001, -E001	Feature Addendum, Host Control Interfaces for IGX
REDCOM Laboratories, Inc. 008836-001, -E002	Feature Addendum, Basic for IGX

* Delivered with module

3.0   REQUIREMENTS

3.1   Module Definition

The Large Voice Module (LVM) provides access for analog and digital voice users and PRI/DS1 connectivity to the Switch Circuit Network ICAP backbone. Some of the standard and configurable functions are:

- User Access for:
  - Analog (POTS)
  - Digital ISDN-BRIs
  - KY-68 Interface
  - Secure push-to-talk (PTT) radio
  - Analog FXO (foreign exchange office) trunks
  - E&M trunks
  - Analog Trunk programmable single frequency (SF) signaling to connect to TRI TAC circuit switches and/or commercial SF trunks.

- Backbone Connectivity for:
  - ISDN-PRI Trunk
  - T-1 Trunk
  - E-1 Trunk

The Large Voice Module application in TDC ICAP is presented graphically in Figure . The standard configuration are shown as bold and configurable functions are shown as gray.
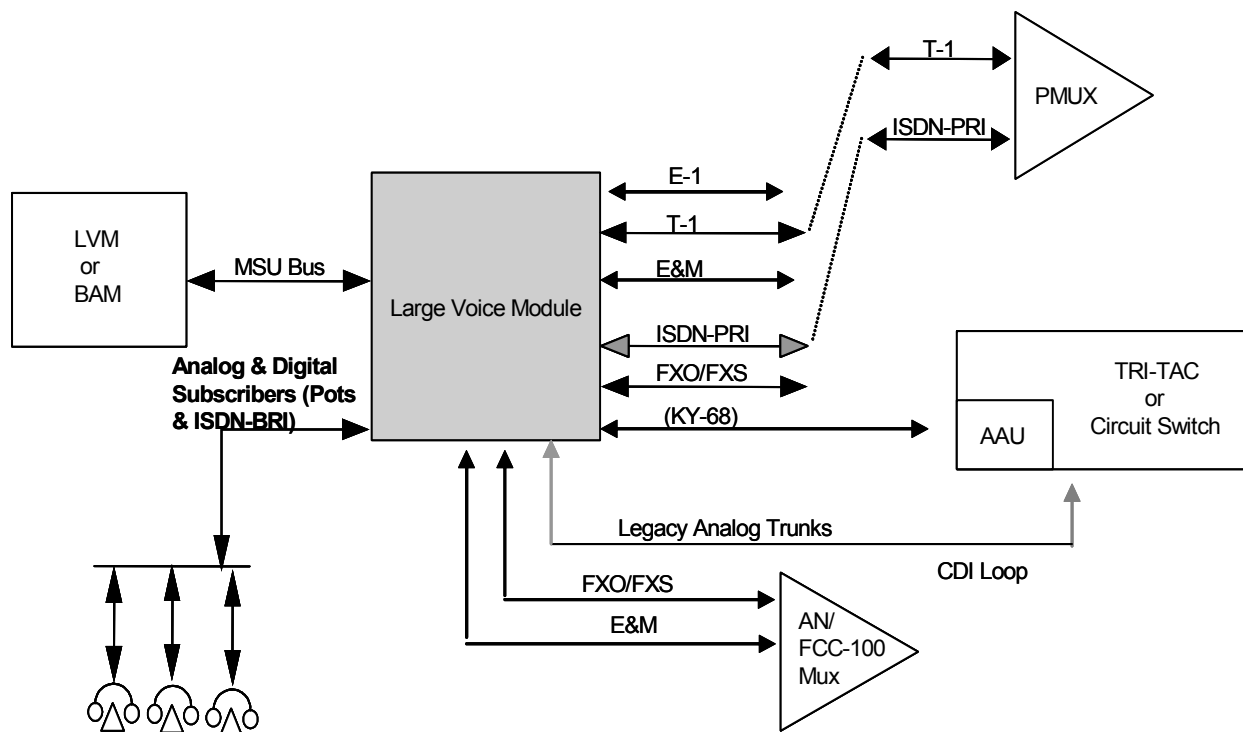
Figure 1 - Large Voice Application in TDC ICAP

Figure 2 shows the Large Voice Module internal and external interconnections. Detailed characteristics for each function are in Paragraph 3.2.
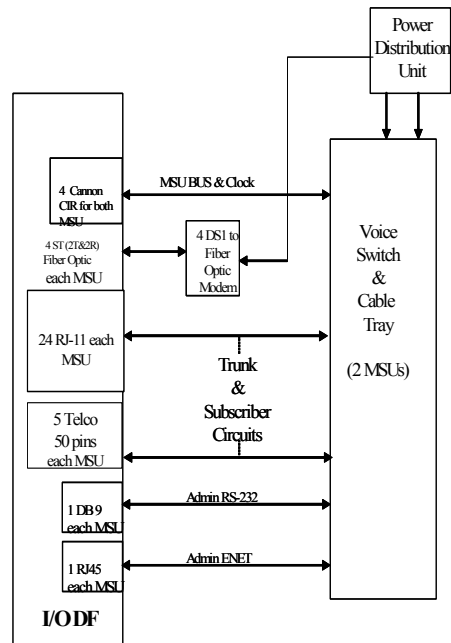
Figure 2 - LVM Internal Functional Block Diagram

3.2   Performance Requirements

3.2.1   Electrical Interface Requirements (External)

Access to the Large Voice Module is through the module's Distribution Frames (DF). The DFs are internally wired to provide all the required connections, except the input power. The input power connection is at the power conditioner. The access ports on the DFs include the number and type of external interfaces presented in Table 2.

Table 2 - LVM External Interface Characteristics

Signal Name	Number	Connector	Input/Outpu	Primary Interface	Electrical Characteristics
Prime Power	1	IEC 320 C20 Receptacle	I	Local power source	100-130 and 200-240, 50-60 HZ, single phase, three wire power.
PRI/DS1	4	ST (T/R)	I/O	BAM, LVM, or P-MUX	ANSI T1.603-1990
Switch Bus	2	Cannon CIR 20R	I/O	BAM or another LVM	Circuit switch proprietary.
Clock Sync	2	Cannon CIR 20 R	I/O	BAM or another LVM	Circuit switch proprietary.

Table 2 - LVM External Interface Characteristics

Signal Name	Number	Connector	Input/ Outpu	Primary Interface	Electrical Characteristics
Remote Voice Connectors	10	Telco-50	I/O	Remote DF	ANSI TIA/EIA-470-B 1997, ANSI T1.601 1992; 2 and 4 wire analog and/or digital voice access
Voice User Access	48	RJ-11 (zone)	I/O	Analog & digital user access	ANSI TIA/EIA-470-B 1997, ANSI T1.601 1992; 24 each 2-wire analog or digital subscriber lines
PRI/DS1	4	RJ-45	I/O	BAM or another LVM / Line Drivers	T1 with transmit and receive pairs in RJ-45
Voice Switch Administration 10BaseT Enet	2	RJ-45	I/O	Personal Computer / IP Network	EIA-802.3
Voice Switch Administration RS-232	2	DB-9F	I/O	VT-100 type terminal	EIA-232

3.2.1.1   Prime Power

In accordance with the TDC Standards Document, the Large Voice Module is designed to operate from 100-130 and 200-240, 50-60 Hz, single phase, three wire power. The Large Voice Module includes an internal power conditioner to minimize line variation and transients. The prime power connector is an IEC 320- C20 receptacle. Separate breakers are provided on the power conditioner for each prime component; Voice Switch, DS1 to Fiber Optic Modem, etc.

3.2.1.2   DS1Backbone

The ISDN-PRI backbone signals are 1.544 Mbps serial data and can be formatted as either ISDN PRI or T-1s trunks. The four backbone connections are made on the distribution frame with eight type ST, fiber optic connector jacks (four transmits and four receives). Also additional DSI/PRI are accessible either directly at the cards or through the RJ-45s via zone connections.

- When configured as ISDN PRI digital trunk connections the DS1s has the following features and characteristics:
    - Electrical interface is the same as T-1 with B8ZS line coding.
    - 23 ISDN B-channels mapped into 23 DS0 T-1 channels.
    - 64 Kbps D-channel mapped into 24th DS0 T-1 channel.
    - Digital Subscriber System No. 1 D-Channel signaling.
    - Access procedures as defined in ITU recommendations Q.920, Q921, Q9.30, Q.931 and X.25.
- When configured as T-1 digital trunk connections the DS1 has the following features and characteristics:
    - Electrical characteristics in accordance with ANSI Standard T-1.102

- Programmable at the circuit switch to support both super frame (SF) and extended superframe in accordance with ANSI Standard T1.107.
- Programmable at the circuit switch to support both AMI (alternate mark inversion) and B8ZS (bipolar 8-zero suppression) line codes.
- Line signaling in accordance with Table 3.

Table 3 - Signaling Protocols Supported

Signaling Type	Standard
E & M (R1)	ITU (CCITT) Q.310 -- Q.326
FX Loop Start	ATT Publication 43801 Section C
FX Ground Start	ATT Publication 43801 Section C

3.2.1.3   Switch Bus

The Voice Switch Bus connectors are Cannon CIR 020R jacks with the pinouts being proprietary. A cable suitable to interconnect two LVMs or a LVM and BAM are supplied with each LVM.

3.2.1.4   Clock Sync

The Clock Sync pinouts are proprietary. The Clock Sync is normally connected to the Voice Switch Bus IN connector. A cable suitable to interconnect two LVMs or a LVM and a BAM are supplied with each LVM.

3.2.1.5   Remote Voice Connectors

The ten Remote Voice connectors are Telco-50 pin receptacles. The Remote Voice connectors provide up to 24 each 2-wire analog and/or digital connections (POTS, ISDN-BRI, etc.). Pin assignments are shown in the following table.

Table 4 - Telco-50 Remote Voice Connections

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
1	Ring	26	Tip	13	Ring	38	Tip
2	Ring	27	Tip	14	Ring	39	Tip
3	Ring	28	Tip	15	Ring	40	Tip
4	Ring	29	Tip	16	Ring	41	Tip
5	Ring	30	Tip	17	Ring	42	Tip
6	Ring	31	Tip	18	Ring	43	Tip
7	Ring	32	Tip	19	Ring	44	Tip
8	Ring	33	Tip	20	Ring	45	Tip
9	Ring	34	Tip	21	Ring	46	Tip
10	Ring	35	Tip	22	Ring	47	Tip
11	Ring	36	Tip	23	Ring	48	Tip
12	Ring	37	Tip	24	Ring	49	Tip

Table 4 - Telco-50 Remote Voice Connections

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
				25	N/C	50	N/C

3.2.1.6   Voice User Access

The (24 upper and 24 lower) Voice User Access connectors are RJ-11s and in the basic configuration Secto R(6) is wired via the zone connectors to provide 48 two wire analog subscriber ports that have the following features and characteristics:

- Analog Subscriber
  - 2-Wire loop start interface compatible with ANSI TIA/EIA-470-B 1997 instruments.
  - Support for dual tone multi-frequency (DTMF) or pulse (rotary) dialing in accordance with ANSI TIA/EIA-470-B 1997.
  - RJ-11 connectors -- Ring (pin 3); Tip (pin 4); Zone (1 – 6) connectors A, B, C and D.

3.2.1.7   Administration

The Voice Switch Administration ports are in accordance with the DB-9F RS-232 standards pin assignments as shown in the following table, using a VT100 Emulator (9600 bps, No Parity, 8 Data Bits, 1 Stop Bit):

Table 5 - Voice Switch Administration RS232

Pin	Signal	Pin	Signal	Pin	Signal
1	Not Used	4	Not Used	7	Request to Send
2	Received Data	5	Signal Ground	8	Clear to Send
3	Transmitted Data	6	Not Used	9	Not Used

Pins 1, 4, and 6 are tied together at the interface panel.

3.2.1.8   Voice Switch Administration 10BaseT Ethernet

The 10BaseT input ports are in accordance with the eight-wire ANSI/IEEE Std 802.3 10BaseT Standards. The connectors are RJ 45 Modular Jacks. Pin assignments are in accordance with the table below.

Table 6 - Voice Switch Adminstration 10BaseT Ethernet

Pin	Signal	Pin	Signal	Pin	Signal
1	TP0+	4	TP2+	7	TP3+
2	TP0-	5	TP2-	8	TP3-
3	TP1+	6	TP1-		

3.2.2   Electrical Interfaces Requirements (Internal)

The module shall be wired with a series of RJ-45 Zone Connectors at the front of the module which shall allow any circuit card in the REDCOM IGXs to be connected to any output of the 50-pin connectors at the rear of the module. The output at the rear of the module shall be in accordance with the TIA 568-A wiring convention.

Internal module interconnections and cable diagrams are provided in Section 6. The documentation shows the internal wiring of the major module components and the details of each major cable assembly internal to the module distribution frame.

3.2.3   Functional Requirements

3.2.3.1   Basic Configuration

The LVM is a flexible, scaleable and configurable module, which performs Switched Circuit Network functions (Figure 1). The LVM includes a two-shelf circuit switch that implements a private branch exchange (PBX). The LVM provides four ISDN-PRI, four via fiber optic at the I/O DF; two RJ-45s at the I/O DF or through LMSU 0 or 1 Sectors (1 – 5) Telco connectors. The PRI s can be interconnected to the network hub or to another network node. The basic circuit switch configuration; i.e., no optional circuit cards; provides service for up to twenty-four 2-wire analog, eight ISDN-BRI subscribers, and 4 ISDN-PRI trunk connections (Figure 3). The circuit switch is a REDCOM IGX*C Exchange.

The installer may customize the switch by adding additional line replaceable units (circuit cards) for increased subscriber access and switch functionality. The circuit switch provides the features in Table 7.
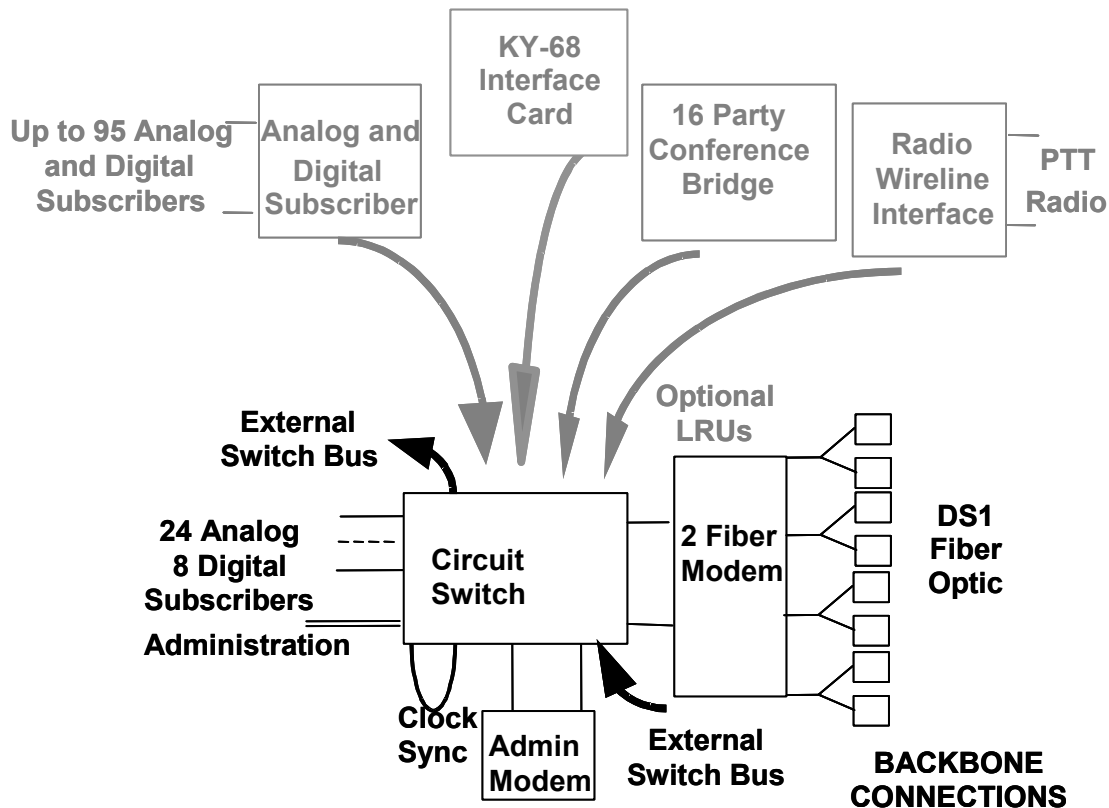
Figure 3 - Functions and Options

External circuit switch backplane bus connections are provided so that multiple LVMs (up to a maximum of 4 units) may be connected together to form a single voice circuit switch. These connections permit additional SCN subscribers to be added as a mission grows.

Primary lightning protection is external to the module for safety.

3.2.3.1.1 Local Subscriber Access

The LVM v2, in its basic configuration, provides access to the Circuit Switch for 24 local telephone subscribers via 2-wire analog circuits. Additionally, the switch can support POTS (WECO 2500), faxes, modems, STU IIIs, and 4 ISDN-BRI "S" digital subscribers, i.e. digital phones and video teleconference units.

3.2.3.1.2 Voice Switch Administration

The LVM v2 provides the capability for the management of the voice switch through a local laptop computer via the Voice Switch Admin connector at the module's I/O DF or from a remote location through a LAN connection. Management of the following functions is provided:

a) Configuration
b) Health and Status
c) Control
d) Downloading statistical data

Table 7 - Voice Switch Features

AUTOVON	Multi Level Precedence and Preemption (MLPP) & PRIORITY FEATURES-provides for processing emergency calls. There are six levels of emergency override.
SITE DOCS/PSR	SITE DOCS/V-LIST-provides the ability to execute the Site Office Records program available on a PCMCIA card. This program will automatically generate IGX system information including details on the following: Hardware Configuration, Dialing Plan, Trunks, Lines, and System Tables.
TOLL RESTRICTION	TOLL RESTRICTION FEATURE- provides the capability to restrict originating lines and trunks from accessing specified trunks, and to restrict the digits that they may dial on those trunks.
CO MF	MF SIGNALLING FEATURE-provides the ability for the switch to interpret Central Office Multi-Frequency signaling. The MF Sender/Receiver card is needed for this feature to work.
CUSTOM	ROSMI CUSTOM FEATURE- provides the ability for the switch to interface to the KY-68 Interface card.
HOST	HOST COMPUTER CONTROL (CTI) FEATURE- provides user access to the IGX Host Control Interface. This allows control of switching functions through an external host computer.
BOOK	Creates a phonebook (i.e. a database) of PBX users.
BASIC	Basic Program Language
CHAIN	Conference Chaining
LAW CONVERSION	IGATE
CLUSTER	Multi Cluster Feature
International	International Feature
ISDN	ISDN Features
EXP-ANN	Expanded Announcer Support
VOIP	Voice Over IP Support
619A	619A-PRI MLPP Support
MET	Multi E1/T1 Support
EISDN	Euro ISDN Support
CLASS	CO Class Features

3.2.3.1.3   Circuit Switch Interconnection

The Circuit Switch is configured with external backplane connections to enable multiple switches (up to a maximum of 8) to be interconnected to form a larger switch with "single switch" functionality. Two switches are included in the LVM. When a "single switch" is formed, only one administration connection is required.

3.2.3.1.4   Fiber Optic Modem

The fiber optic modem converts the bi-directional T1 or ISDN PRI trunks to an optical waveform.

3.2.3.2   Configuration Options

In addition to the basic functions and features, the installer may customize the switch by modifying the card complement to provide the additional features. Some of them are listed below:

- In conjunction with the KY-68 Interface Card access to 4 each KY-68s per card
- Up to 95 phone users – 2-wire analog and digital BRI "S"
- Push to Talk (PTT) – Radio wireline Interface
- 16 party conferencing
- E&M – 4 wire Type 1
- T1, E1 Trunks
- Etc.*

* See REDCOM Manual for a more complete listing of the interface and feature options.

The configuration cannot violate the basic configuration rules of the REDCOM IGX•C for the 96 time slots.

3.2.3.2.1   Configuration Kits

The following kits are available to provide additional capabilities to the BAM:

- Local Base Interface Kit – provides for interconnectivity with local PBX systems via LSRD/GSRD trunk and E&M trunk 4-wire boards.

- Radio Interface Kit – provides LST-5 UHF radio interface cards for the switch.

- Subscriber Extension Kit – provides the capability to remotely distribute voice circuits from the voice modules.

- Subscriber Loop Kit – provides additional 2-wire POTS analog and ISDN-BRI S digital interface cards.

- T1 Trunk - Including International and Echo Cancellation – provides increased T1/ISDN-PRI and E1 trunk capability with echo cancellation

- TRI-TAC Interface Kit – provides SF Trunk circuits to interface with TRI-TAC services, such as TTC-39, SB-3865 circuit switches.

- DSVT Kit – provides the capability for 2 each KY-68's per card.

- Lightning Protection Kit

Many of the system level and maintenance kits can be used for LVM module troubleshooting and cable repair. These kits include:

- Fireberd Analyzer Kit – Contains the Fireberd 6000 and interfaces for circuit testing.

- Cable Maintenance Kit – Contains Fiber Optic Time Domain Reflectometer, HP Digital Average Power Meter, Cable Tester, Digital Multimeter, Oscilloscope, RS530 and Breakout Box.

- Voice/Data Cable Kit – Contains Category 5 Twisted Pair materials to make 10/100 BaseT cables (RJ11 and RJ45) with label package.

- Fiber Cable Kit – Contains tactical 1.5 K m of fiber cable, SC/ST connectors and fiber termination tool kit.

- Circuit Extension Kit – Contains Campus Rex T1/E1, T1/E1 Fiber line driver and CV-2048 Modem.

- Laptop Computer Kit – Contains Laptop Computer w/ CD-ROM, Portable Ethernet Sniffer w/ software.

- Small UPS Kit – Provides protection and backup (650VA) of prime power circuits.

- Large UPS Kit – Provides protection and backup (1500VA) of prime power circuits.

3.2.4 Physical Characteristics

3.2.4.1 Transit Case

The module shall be housed in a man-transportable container (transit case). The transit cases are designed to stack on top of and mechanically interlock to like cases; interior equipment frame slides out for access. The transit cases with their covers in place are designed to protect the electronic equipment inside from direct exposure to environmental conditions; e.g., rain, snow, ice, dust, etc., likely to be encountered during world wide military transit.

3.2.4.2 Weight

The module, including all internally carried cables, does not exceed TBD pounds.

3.2.4.3 Storage Space

The module transit case includse storage pouches within its covers to contain cables, manuals, etc. that must be transported and used with the module.

3.2.4.4 Marking

See TDC Standards Document for required markings.

3.2.5 Cables and Accessories

The module includes the cables and terminators listed in Table 8. Strain relief and cable management hardware are provided with the module.

Table 8 - Cables and Terminators Included with LVM

Device	Manufacturer	Part Number	Description	Quantity
Modular Y Adapter	SIEMON	YT4-U2-U2	4-Pair T568A Jack into two 4-pair T568A	6
6-Position 568A Harmonica with Telco Connector	SIEMON	H50M06MJ8-TIA	ISDN Harmonica with RJ-45 stored in module lids or drawer (male to female)	1
Connector	Fiber Systems International	BSTA2000	Bulkhead Coupler	4
(P1) Cable	TBD	TBD	Power Cable IEC-320 female (or equivalent) to NEMA-5P (stored in pouch)	1
(P2) Cable	REDCOM	CA9079-T08	Cable Assembly F CLK to Bus In (stored in pouch)	1
(P3) Cable	REDCOM	CA9079-T3A	Cable Assembly E1 Bus Terminator (stored in pouch)	1
(P4) Cable	REDCOM	CA9079-T3B	Cable Assembly E2 Bus Terminator (stored in pouch)	1
(P5) Cable	REDCOM	CA9079-T5B	Cable Assembly G2 (5-pin) Clock Synch (stored in pouch)	1
(P6) Cable	REDCOM	CA9079-240	Cable Assembly Bus In to Bus Out (stored in pouch)	1
(P7) Cable	REDCOM	CA9079-140	Cable Assembly CLK In to CLK Out (stored in pouch)	1
(P8) Cable	TBD	TBD	Telco Cable, 50 pin, 10 ft (for module to harmonica) male to female (stored in pouch)	1
(P9-P12) Cable	TBD	TBD	Fiber Optic Backbone Cable (stored in pouch)	4
(W1-W2) Cable	STI	P/O A2, A3 Dual T1 FO Modem	Power Cable, Fiber Optic Modem	2
(W3-W4) Cable	TBD	TBD	Power Cable, MSU 0,1 with fuse protect	2
(W5-W8) Cable	TBD	P/O A6, A7 RJ-45 Zone Patch Panel	T-1 Cable	4
(W9-W12) Cable	TBD	TBD	Fiber Optic T1 Voice Backbone	4
(W13) Cable	REDCOM	SH9079	REDCOM Proprietary Bus In Cable	1
(W14) Cable	REDCOM	CA0490-101	REDCOM Proprietary MPS Bus Cable	1
(W15) Cable	REDCOM	SC0483-001	REDCOM Proprietary TS1 Bus Cable	1
(W16) Cable	REDCOM	SH9079-720	REDCOM Proprietary Bus Out Cable	1
(W17) Cable	REDCOM	SC9079	REDCOM Proprietary Clock In Cable	1
(W18) Cable	REDCOM	SC9079	REDCOM Proprietary Clock Out Cable	1

Table 8 - Cables and Terminators Included with LVM

Device	Manufacturer	Part Number	Description	Quantity
(W19-W20) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	MSU 0, 1 Admin Cable, RS-232	2
(W21-W22) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	Modem Cable	1
(W23-W24) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	MSU 0, 1 Admin Cable, Ethernet	2
(W25-28) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	Direct 0, 1 Cable	4
(W29-38) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	REDCOM Proprietary Sector Cable	10
(W39-W40) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	REDCOM Proprietary Sector Cable	2

Note: This does not include Zone Cables provided with the cards.

3.2.6   Reliability

The module with its standard complement of LRUs, have a mean time between failure (MTBF) commensurate with similar commercial equipment in its class. The actual MTBF for the major system components are shown in Table 9. Where reliability data is not readily available from the vendor, this is indicated.

Table 9 - MTBF of Major Components

Component	MTBF
IGX*C	10,200 hours (estimated)

3.2.7   Maintainability

Maintainability characteristics will be part of the selection criteria for all hardware. Ease of maintenance, such as accessibility to Line Replaceable Units, fault detection/isolation software capability, and fault annunciation will be considered.

3.2.7.1   Mean Time Between Preventive Maintenance

The Mean Time Between Preventive Maintenance, during operation, is 30 days. The duration of preventive maintenance actions such as corrosion control, cleaning filters, etc., does not exceed 30 minutes.

3.2.8   Environmental Conditions

During storage, transport and operation the modules can withstand exposure to temperatures as shown in Table 10.

3.2.8.1   Temperature

Temperature characteristics for the major equipment components are shown in Table 10.

Table 10 - Module Temperature Characteristics

Equipment	Temperature (degrees C)	
	Operating	Non-Operating
IGX*C	0 to 50	Not Available

3.2.8.2   Relative Humidity

Relative humidity characteristics for the major equipment components are shown in Table 11.

Table 11 - Module Humidity Characteristics

Equipment	Humidity
	Non-condensing
IGX*C	5 to 95%

3.2.8.3   Altitude

Altitude characteristics for the major equipment components are shown in Table 12.

Table 12 - Module Altitude Characteristics

Equipment	Altitude (feet)	
	Operating	Non-Operating
IGX*C	Not Available	Not Available

3.2.8.4   Sand and Dust

During storage and transport, the modules are protected when exposed to sand and dust in accordance with the best commercial practices for close proximity to operating aircraft. During operation with covers removed, the modules can withstand sand and dust in accordance with the best commercial practices for natural conditions.

3.2.8.5   Shock

Module equipment racks are equipped with rubber shock isolation mounts and is protected from shocks induced during handling, setup and tear down. Modules and components can operate without degradation following exposure to the non-operating shock environment described by Method 516.5, Procedure VI (Bench Handling) of MIL STD 810F.

3.2.8.6   Vibration

The modules are equipped with rubber shock isolation mounts so that the modules can withstand the vibration encountered while being transported by commercial and military airlift, sealift and vehicular (over unimproved roads) systems. MIL-STD-810F, Method 514.5, Procedure I, Categories 4, 7 and 8 applies; alternative procedures may be substituted after TDC Program Office approval.

3.3   Design and Construction

3.3.1   Material Parts and Processes

This module is built to good commercial practices. Mechanical and electrical interchangeability exists between like systems, subsystems, assemblies, subassemblies and replaceable parts.

3.3.2   Safety

This module shall not present a safety, fire or health hazard to personnel.

3.3.2.1   Electrical Safety

This module is designed to eliminate the hazard to personnel of inadvertent lethal voltage contact. All electrical conductors carrying voltages in excess of 70 volts shall be insulated to prevent contact or covered by a protective barrier. All removable protective barriers shall be interlocked to automatically disconnect power behind the barrier upon removal or clearly marked with a warning label that indicates the voltage potential that will be encountered behind the barrier. All warning labels shall remain visible after the cover has been removed.

3.3.2.2   Mechanical Safety

Sharp surfaces shall have protective covers or other suitable features to minimize injury where personnel are likely to be exposed to such surfaces.

3.4   Logistics

This module accommodates a two level maintenance concept: organizational (Air Force personnel) and depot (contractor personnel). Removal and replacement of an LRU is defined at the organizational level and any needed repair of the LRU is defined at the depot level. Any special test or support equipment required to effect removal or replacement of an LRU at the organizational level can be provided as part of the module. No more than two persons shall be required to remove or replace an LRU.

An LRU is defined as the lowest element of the module which can be isolated to be faulty through inspection; built-in test; technical manuals; TDC-ICAP system performance; spares substitution; or other diagnostic aid approved by the Government for organizational level maintenance, exclusive of expendables such as fuses, lamps and LEDs. An LRU is defined at the card/module level or higher.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 General

The quality assurance program includes tests and other evaluations to the extent specified herein. The quality assurance program is designed to verify the electrical, mechanical and functional characteristics of each module. The purpose is to ensure that each module complies with or performs better than the requirements specified herein.

4.2 Responsibility for Inspection

Unless otherwise specified in the contract, the contractor shall be responsible for the performance of all inspection requirements and may use his own or any other facilities suitable for the performance of the inspection requirements. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to the prescribed requirements.

4.3 Product Qualification Test (PQT)

Inspections, analyses, demonstrations and tests verify compliance of Section 3 of this specification on the first production unit.

4.4 Production Acceptance Test (PAT)

Each module delivered to the Government undergoes an Acceptance Test Process as identified in Table 13. The acceptance test verifies that the module interfaces are operating properly prior to delivery to the Government.

4.5 Verification Cross Reference Matrix (VCRM)

Table 13 provides a list of each Section 3 requirement and the verification method to be used. The following paragraphs define the codes employed in the VCRM. Unless otherwise noted, where more than more one verification method is shown, one method or a combination of methods may be used to show compliance.

4.5.1 Not Required (N/R)

This method indicates that verification is not required because the paragraph is a title, heading, general introductory paragraph or statement of a goal and contains no "shall" or "must" statements.

4.5.2 Inspection

Inspection is a method of verification of the module performance or characteristics by examination of the equipment or associated documentation. Inspections are conducted with the use of inspection tools, measurement devices, visual means and comparison. Most inspections apply to verification of requirements associated with physical characteristics such as size, weight,

appearance, adherence to specified standards and engineering practices, quality design, and construction supported with quality documentation. Inspections also include the auditing of manufacturer's data that verifies the performance of non-developmental items that comprise the TDC ICAP module. Inspections may occur during any assembly stage of the unit under test.

4.5.3   Analysis

Analysis is a method of verification through technical evaluation of calculations, computations, models, analytical solutions, use of studies, reduced data, and/or representative data to determine that the item conforms to the specified requirements.

4.5.4   Demonstration

Demonstration is a method of verification whereby the properties, characteristics and parameters of the item are determined by observation alone and without the use of instrumentation for quantitative measurements. This method is used when a requirement does not contain a specific numerical parameter that must be measured. Demonstrations may occur during verification of a unit under test at any assembly stage. Pass/fail criteria are simple yes/no indications of functional performance since no quantitative values are specified.

4.5.5   Test

Test is a method to verify that a specified requirement is met by thoroughly exercising the applicable item under specified conditions and by using the appropriate instrumentation in accordance with test procedures. This method requires the use of laboratory equipment, simulators, or services to verify compliance to the specified requirements. This method is used when it is practicable to make direct or indirect measurement of a specified numerical parameter to verify compliance with a requirement. Tests may occur during verification of a unit at any assembly stage. Actual measured values are recorded, and pass/fail is determined by comparing the measured value with the specified value. Measurement accuracy is precise enough to ensure that the measured value is within the specified tolerance.

Table 13 - Verification Cross Reference Matrix

Paragraph	Title	N/R	Inspect	Analysis	Demo	Test	ATP
				Verification Method			
				PQT			
3.	REQUIREMENTS	X					
3.1	Module Definition	X					
3.2	Performance Requirements	X					
3.2.1	Electrical Interface Requirements (External)	X					
3.2.1.1	Prime Power					X	X
3.2.1.2	DS1 Backbone				X		
3.2.1.3	Switch Bus				X		
3.2.1.4	Clock Sync				X		

Table 13 - Verification Cross Reference Matrix

Paragraph	Title	N/R	Inspect	Analysis	Demo	Test	ATP
			PQT				
3.2.1.5	Remote Voice Connectors				X		
3.2.1.6	Voice User Access				X		
3.2.1.7	Admin				X		
3.2.2	Electrical Interfaces Requirements (Internal)	X				X	
3.2.3	Functional Requirements	X					X
3.2.3.1	Basic Configuration	X					X
3.2.3.1.1	Local Subscriber Access				X		X
3.2.3.1.2	Voice Switch Administration				X		X
3.2.3.1.3	Circuit Switch Interconnection				X		X
3.2.3.1.4	Fiber Optic Modem				X		X
3.2.3.2	Configuration Options	X					
3.2.3.2.1	Configuration Kits	X					
3.2.4	Physical Characteristics	X					
3.2.4.1	Transit Case		X				
3.2.4.2	Weight					X	
3.2.4.3	Storage Space		X				
3.2.4.5	Marking		X				
3.2.5	Cables and Accessories				X		
3.2.6	Reliability			X			
3.2.7	Maintainability			X			
3.2.7.1	Mean Time Between Preventive Maintenance [MTBPM]			X			
3.2.8	Environmental Conditions	X					
3.2.8.1	Temperature					X	
3.2.8.2	Humidity			X			X
3.2.8.3	Altitude			X			X
3.2.8.4	Sand and Dust			X			
3.2.8.5	Shock					X	
3.2.8.6	Vibration					X	
3.3	Design and Construction	X					
3.3.1	Materials Parts and Processes			X			
3.3.2	Safety		X				
3.3.2.1	Electrical Safety			X		X	
3.2.2.2	Mechanical Safety		X	X			
3.4	Logistics			X			

5.0   PREPARATION FOR DELIVERY

Each module is packaged for shipment and the package marked in accordance with the requirements of the contract under which the module is ordered.

6.0   BASELINE CONFIGURATION

6.1   Equipment

Table 14 - Equipment Listing

Device	Manufacturer	Part Number	Description	Quantity
Case	ECS Composites	TBD	Transit Case	1
Power Conditioner	Marway	411355	Power Conditioner	1
Fiber Optic Modem	STI	2890-2R-ASP-1	Dual T1 Fiber Optic Modem	2
Circuit Switch	REDCOM	IGX*C Standard Shelf	Circuit switch single shelf	2
Software	REDCOM	6.X rX.pX - TDC	Version 6.X RX, PX	2
Software	REDCOM	AUTOVON	MLPP and Priority Feature	2
Software	REDCOM	619A	PRI MLPP	2
Software	REDCOM	Toll Restriction	Toll Restriction Feature	2
Software	REDCOM	CO MF	MF Signaling Feature	2
Software	REDCOM	CUSTOM	ROSMI Custom Feature	2
Software	REDCOM	HOST	Host Computer Control (CTI) Feature	2
Software	REDCOM	PSR	Print Site Records Feature	1
Software	REDCOM	Book	Phonebook	1
Software	REDCOM	Basic	Basic Program Language	2
Software	REDCOM	Chain	Conference Chaining	2
Software	REDCOM	Law Conversion	IGATE	2
Software	REDCOM	Cluster	Multi Cluster Feature	2
Software	REDCOM	International	International Feature	2
Software	REDCOM	ISDN	ISDN Features	2
Software	REDCOM	EXP-ANN	Expanded Announcer Support	2
Software	REDCOM	VOIP	Voice over IP Support	2
Software	REDCOM	MET	Multi E1/T1 Support	2
Software	REDCOM	EISDN	Euro ISDN Support	2
Software	REDCOM	CLASS	CO CLASS Features	2
Timeslot Interchange	REDCOM	MA0689-001	Voice Matrix	2
MSU Controller	REDCOM	TK0640-017	Supervisor and Control Board Set	2
Ring Generator	REDCOM	TK0060-005	Switch Ring Generator	2
Line Circuit Board	REDCOM	TK0653-113	8 Circuit Expanded Line Board	3
MF Sender/Receiver Board	REDCOM	TK0520-102	MF Sender/Receiver Board 8 Circuit	1
MTI Board	REDCOM	TK0463-101	MTI User Config Board	2
CLK SYNC Board	REDCOM	TK0473-163	Universl CLK Sync Perm SW/ OVR	1

Table 14 - Equipment Listing

Device	Manufacturer	Part Number	Description	Quantity
ISDN BRI S Board	REDCOM	TK0531-322	ISDN S Board, 4 circuits or lines/card	2
Dual DS1 Board	REDCOM	TBD	Trunk, 2 each, DS1 Single Board with Echo Cancellation	2
RJ-45 Zone/Patch Panel	REDCOM	TBD	RJ-45 Patch Panel	2
Cable Management Bar	Leviton Telcom	41150-019	Polyrack Cable Management Bar	2
Cable Loop	Leviton Telcom	41020-SPR	Polytie Cable Loop	2
Modular Y Adapter	SIEMON	YT4-U2-U2	4-Pair T568A Jack into two 4-pair T568A	6
6-Position 568A Harmonica with Telco Connector	SIEMON	H50M06MJ8-TIA	ISDN Harmonica with RJ-45 stored in module lids or drawer (male to female)	1
Connector	Fiber Systems International	BSTA2000	Bulkhead Coupler	4
(P1) Cable	TBD	TBD	Power Cable IEC-320 female (or equivalent) to NEMA-5P (stored in pouch)	1
(P2) Cable	REDCOM	CA9079-T08	Cable Assembly F CLK to Bus In (stored in pouch)	1
(P3) Cable	REDCOM	CA9079-T3A	Cable Assembly E1 Bus Terminator (stored in pouch)	1
(P4) Cable	REDCOM	CA9079-T3B	Cable Assembly E2 Bus Terminator (stored in pouch)	1
(P5) Cable	REDCOM	CA9079-T5B	Cable Assembly G2 (5-pin) Clock Synch (stored in pouch)	1
(P6) Cable	REDCOM	CA9079-240	Cable Assembly Bus In to Bus Out (stored in pouch)	1
(P7) Cable	REDCOM	CA9079-140	Cable Assembly CLK In to CLK Out (stored in pouch)	1
(P8) Cable	TBD	TBD	Telco Cable, 50 pin, 10 ft (for module to harmonica) male to female (stored in pouch)	1
(P9-P12) Cable	TBD	TBD	Fiber Optic Backbone Cable (stored in pouch)	4
(W1-W2) Cable	STI	P/O A2, A3 Dual T1 FO Modem	Power Cable, Fiber Optic Modem	2
(W3-W4) Cable	TBD	TBD	Power Cable, MSU 0,1 with fuse protect	2
(W5-W8) Cable	TBD	P/O A6, A7 RJ-45 Zone Patch Panel	T-1 Cable	4
(W9-W12) Cable	TBD	TBD	Fiber Optic T1 Voice Backbone	4
(W13) Cable	REDCOM	SH9079	REDCOM Proprietary Bus In Cable	1
(W14) Cable	REDCOM	CA0490-101	REDCOM Proprietary MPS Bus Cable	1

Table 14 - Equipment Listing

Device	Manufacturer	Part Number	Description	Quantity
(W15) Cable	REDCOM	SC0483-001	REDCOM Proprietary TS1 Bus Cable	1
(W16) Cable	REDCOM	SH9079-720	REDCOM Proprietary Bus Out Cable	1
(W17) Cable	REDCOM	SC9079	REDCOM Proprietary Clock In Cable	1
(W18) Cable	REDCOM	SC9079	REDCOM Proprietary Clock Out Cable	1
(W19-W20) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	MSU 0, 1 Admin Cable, RS-232	2
(W21-W22) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	Modem Cable	1
(W23-W24) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	MSU 0, 1 Admin Cable, Ethernet	2
(W25-28) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	Direct 0, 1 Cable	4
(W29-38) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	REDCOM Proprietary Sector Cable	10
(W39-W40) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	REDCOM Proprietary Sector Cable	2

Note: Zone Cables are considered part of the associated card assembly.
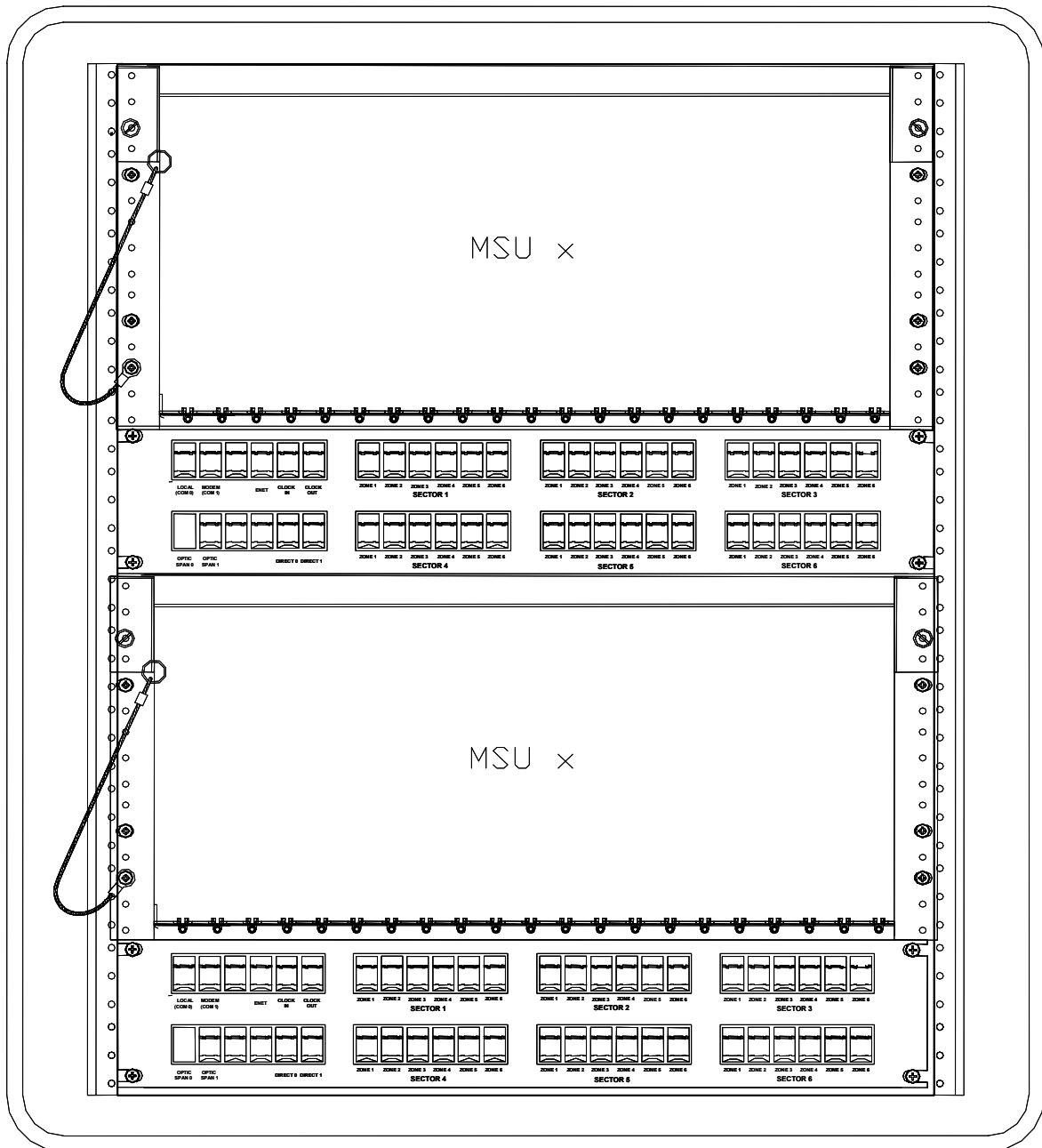
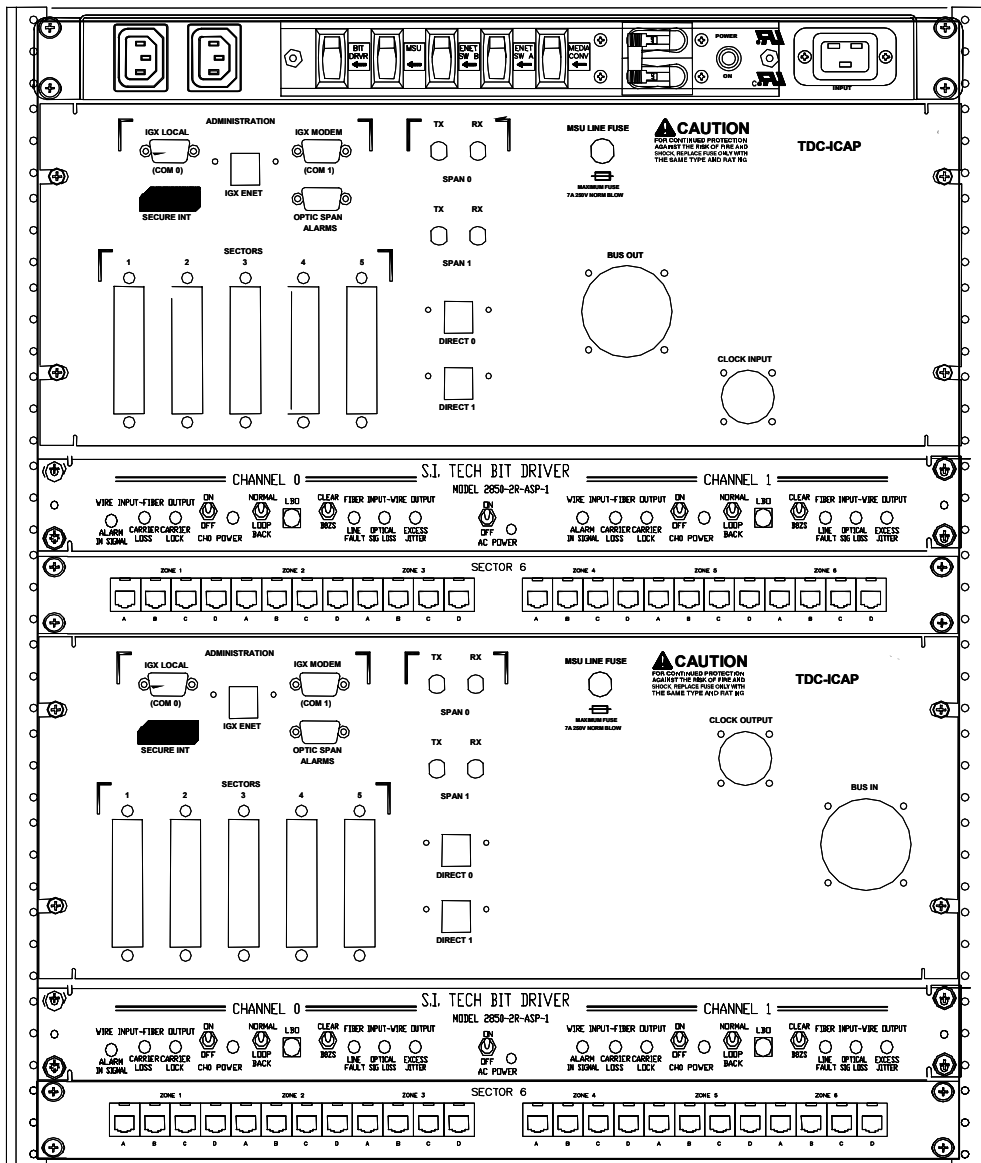## 6.2   Elevation Drawings

Figure 4 - Front Elevation Drawing

Figure 5 - Rear Elevation

6.3   Cable Diagrams

Table 15 - Cable Listing

Device	Manufacturer	Part Number	Description	Quantity
Modular Y Adapter	SIEMON	YT4-U2-U2	4-Pair T568A Jack into two 4-pair T568A	6
6-Position 568A Harmonica with Telco Connector	SIEMON	H50M06MJ8-TIA	ISDN Harmonica with RJ-45 stored in module lids or drawer (male to female)	1
Connector	Fiber Systems International	BSTA2000	Bulkhead Coupler	4
(P1) Cable	TBD	TBD	Power Cable IEC-320 female (or equivalent) to NEMA-5P (stored in pouch)	1
(P2) Cable	REDCOM	CA9079-T08	Cable Assembly F CLK to Bus In (stored in pouch)	1
(P3) Cable	REDCOM	CA9079-T3A	Cable Assembly E1 Bus Terminator (stored in pouch)	1
(P4) Cable	REDCOM	CA9079-T3B	Cable Assembly E2 Bus Terminator (stored in pouch)	1
(P5) Cable	REDCOM	CA9079-T5B	Cable Assembly G2 (5-pin) Clock Synch (stored in pouch)	1
(P6) Cable	REDCOM	CA9079-240	Cable Assembly Bus In to Bus Out (stored in pouch)	1
(P7) Cable	REDCOM	CA9079-140	Cable Assembly CLK In to CLK Out (stored in pouch)	1
(P8) Cable	TBD	TBD	Telco Cable, 50 pin, 10 ft (for module to harmonica) male to female (stored in pouch)	1
(P9-P12) Cable	TBD	TBD	Fiber Optic Backbone Cable (stored in pouch)	4
(W1-W2) Cable	STI	P/O A2, A3 Dual T1 FO Modem	Power Cable, Fiber Optic Modem	2
(W3-W4) Cable	TBD	TBD	Power Cable, MSU 0,1 with fuse protect	2
(W5-W8) Cable	TBD	P/O A6, A7 RJ-45 Zone Patch Panel	T-1 Cable	4
(W9-W12) Cable	TBD	TBD	Fiber Optic T1 Voice Backbone	4
(W13) Cable	REDCOM	SH9079	REDCOM Proprietary Bus In Cable	1
(W14) Cable	REDCOM	CA0490-101	REDCOM Proprietary MPS Bus Cable	1
(W15) Cable	REDCOM	SC0483-001	REDCOM Proprietary TS1 Bus Cable	1
(W16) Cable	REDCOM	SH9079-720	REDCOM Proprietary Bus Out Cable	1
(W17) Cable	REDCOM	SC9079	REDCOM Proprietary Clock In Cable	1

Table 15 - Cable Listing

Device	Manufacturer	Part Number	Description	Quantity
(W18) Cable	REDCOM	SC9079	REDCOM Proprietary Clock Out Cable	1
(W19-W20) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	MSU 0, 1 Admin Cable, RS-232	2
(W21-W22) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	Modem Cable	1
(W23-W24) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	MSU 0, 1 Admin Cable, Ethernet	2
(W25-28) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	Direct 0, 1 Cable	4
(W29-38) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	REDCOM Proprietary Sector Cable	10
(W39-W40) Cable	REDCOM	P/O A6, A7 RJ-45 Zone Patch Panel	REDCOM Proprietary Sector Cable	2

Cable P1 (TBSL
Power Cable (stored in pouch)
Pin Assignments

NEMA-5P   IEC-320
Plug   Receptacle
                Power Distribution
                Unit- A1
Power   Power

	Signal	**Direction**	
1	Line	-----	1
2	Neutral	-----	2
3	GND	-----	3

Cable P8 (TBSL)
DB50 to Telco Conversion Cable (stored in pouch)
Pin Assignments

DB50 (FEMALE)	Telco 50M
Receptacle	Receptacle
AMP 205211-2	AMP 229974-1
Protector Block	I/O DF
P8	Zones 19-24

	Signal	**Direction**	
1	RING	←→	1
26	TIP	←→	26
2	RING	←→	2
27	TIP	←→	27
.	RING	←→	.
.	TIP	←→	.
23	RING	←→	23
48	TIP	←→	48
24	RING	←→	24
49	TIP	←→	49
25	N/C		25
50	N/C		50

Note: straight through connections

Cable P9-P12 (TBSL)
Fiber Optic Backbone Cable (stored in pouch)
Pin Assignments

ST	ST
Plug	Plug

	Signal	**Direction**	
1	Tx	→	1
2	Rx	←	2

Cable W3&W4 (CH9079-P36)
Switch-A2 Power Cable
Pin Assignments

IEC-320   IEC-320
Receptacle   Plug
Switch-A2 (MSU0/1)   Power Distribution
                           Unit- A5
Power   Power

	Signal		**Direction**		
1	Line	FUSE	-----	1
2	Neutral		-----	2
3	GND		-----	3

Cable W9 – W12 (TBSL)
Voice Backbone Fiber Optic Cable
Pin Assignments

SST   ST
Plug   Plug
Dual T1   I/O DF
FO Modem   I/O DF

	Signal	**Direction**	
1	Tx	→	1
2	Rx	←	2

Module Admin Cable (stored in pouch)
Pin Assignments

DB9F   DB9M
Receptacle   Plug
AMP 745491-2   AMP 745906-1
Laptop COM port   I/O DF
Terminal   Various Admin
DTE

	Signal	Direction	
2	RD	←	2
3	TD	→	3
4	DTR	→	4
5	GND	----	5
6	DSR	←	6
7	RTS	→	7
8	CTS	←	8

6.4   Interconnect Diagram
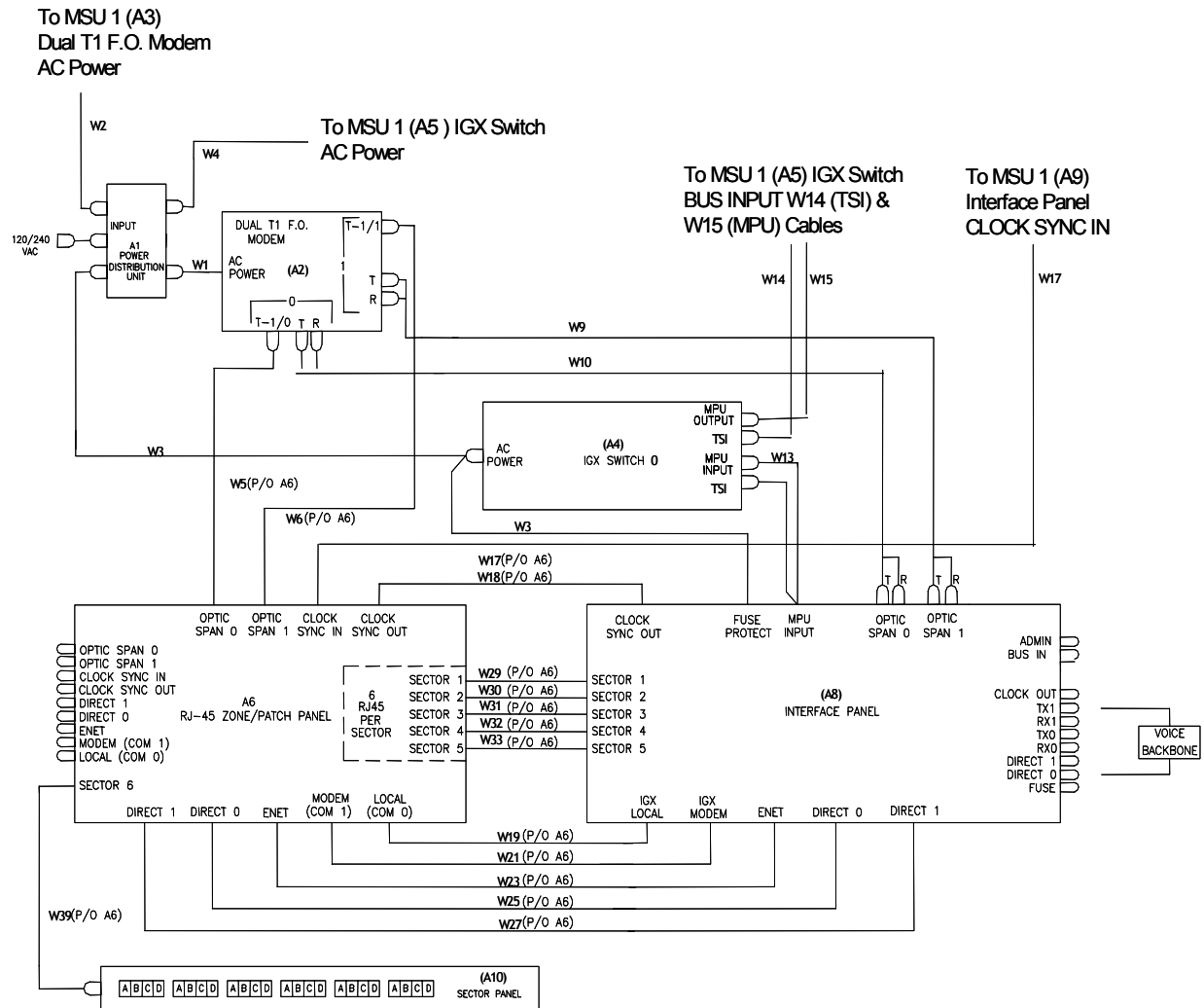
Figure 6 - Interconnect Diagram MSU 0

To (A1) Power Conditioning Unit

To MSU 0 (A6)
RJ-45 Zone/Patch Panel
CLOCK SYNC IN

To MSU 0 IGX Switch
(A4) MPU Output
W14 (TSI) & W15 (MPU)
Cables

W4   W2

DUAL T1 F.O.
MODEM
AC
POWER   (A3)
T-1/1
1
T
R
0
T-1/0 T R

W11
W12

W14 W15   W17

MPU
OUTPUT   W16
TSI
MPU
INPUT
TSI

AC
POWER
A5
IGX SWITCH 1

W4

W4

W7 (P/O A7)

W8 (P/O A7)

W4

W17 (P/O A6)

T R   T R

OPTIC   OPTIC
SPAN 0 SPAN 1

CLOCK   FUSE   MPU   OPTIC   OPTIC
SYNC IN PROTECT   OUTPUT SPAN 0 SPAN 1

ADMIN

OPTIC SPAN 0
OPTIC SPAN 1
CLOCK SYNC IN
CLOCK SYNC OUT
DIRECT 1
DIRECT 0
ENET
MODEM (COM 1)
LOCAL (COM 0)

SECTOR 6

(A7)
RJ-45 ZONE/PATCH PANEL

6
RJ45
PER
SECTOR

SECTOR 1
SECTOR 2
SECTOR 3
SECTOR 4
SECTOR 5

W34 (P/O A7)
W35 (P/O A7)
W36 (P/O A7)
W37 (P/O A7)
W38 (P/O A7)

SECTOR 1
SECTOR 2
SECTOR 3
SECTOR 4
SECTOR 5

(A9)
INTERFACE PANEL

BUS OUT
CLOCK IN
TX1
RX1
TX0
RX0
DIRECT 1
DIRECT 0
FUSE

VOICE
BACKBONE

DIRECT 1 DIRECT 0 ENET
MODEM   LOCAL
(COM 1) (COM 0)

IGX   IGX
LOCAL   MODEM   ENET   DIRECT 0   DIRECT 1

W20 (P/O A7)
W22 (P/O A7)
W24 (P/O A7)
W26 (P/O A7)
W28 (P/O A7)

W40 (P/O A7)

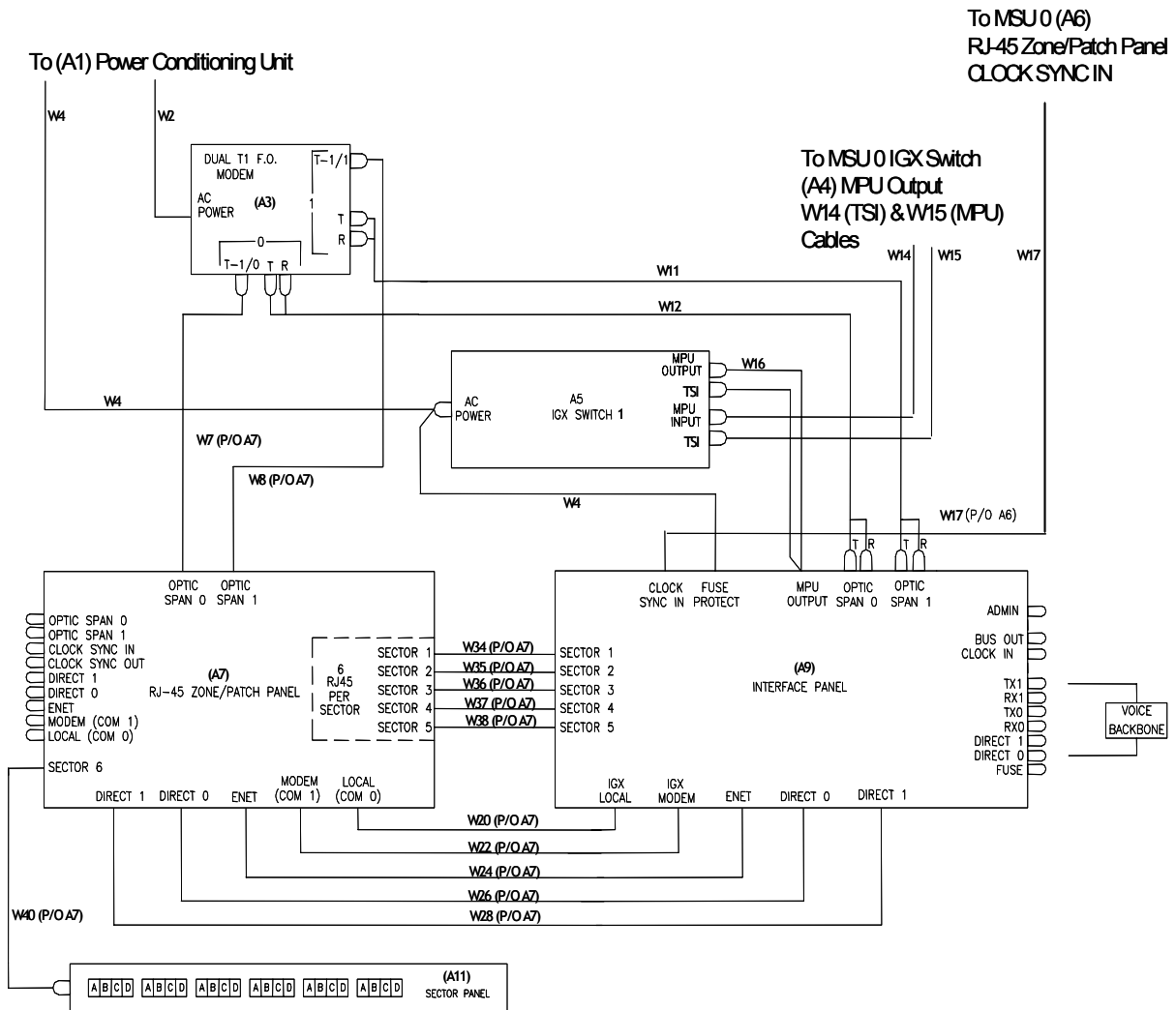A B C D A B C D A B C D A B C D A B C D A B C D
(A11)
SECTOR PANEL

Figure 7 - Interconnect Diagram MSU 1